

e-Ship: radiological transport assistant

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CERN
European Organisation
for Nuclear Research

nucleonica ... web driven nuclear science

Applications Data Knowledge My Preferences Print Networking Nuclear Science Help New Browser Logout

Version: 2013.04.11 18:26:58

e-Ship
radiological transport assistant

This is a beta version of the new web application e-Ship. Please report errors to info@nucleonica.com.

Getting started
Reference manual

Questions, remarks, suggestions can be posted in the forum

My Packages Edit Options Decay Import Activity limits CERN file Sample packages About e-Ship

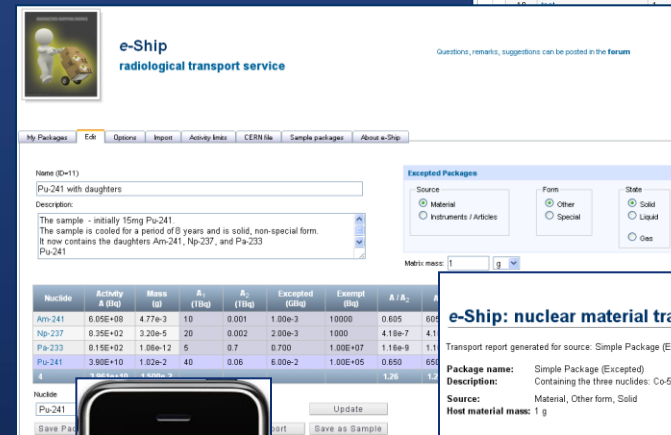
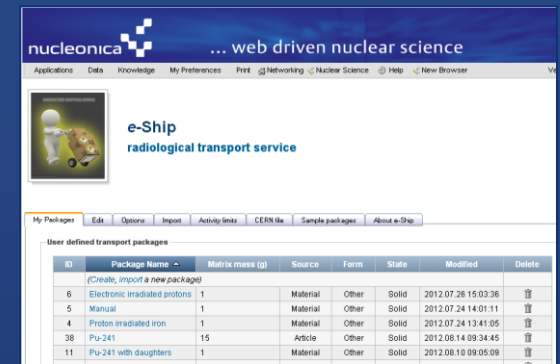
Selected columns of the package grid

General	ICRP	Swiss RPO	IAEA Transport
<input type="checkbox"/> MatIndex	<input type="checkbox"/> e_{ing} (Sv/Bq)	<input type="checkbox"/> LE (Bq)	<input checked="" type="checkbox"/> A_1
<input checked="" type="checkbox"/> Mass	<input type="checkbox"/> e_{inh} (Sv/Bq)	<input type="checkbox"/> LA (Bq)	<input checked="" type="checkbox"/> A_2
<input checked="" type="checkbox"/> Half-life	<input type="checkbox"/> E_{ing} (mSv)	<input type="checkbox"/> A (Bq) / LE_{30s} (Bq)	<input checked="" type="checkbox"/> Excepted
<input type="checkbox"/> Decay modes	<input type="checkbox"/> E_{inh} (mSv)	<input type="checkbox"/> A (Bq/kg) / LE (Bq/kg)	<input checked="" type="checkbox"/> Exempt (Bq)
		<input type="checkbox"/> A (Bq) / LA (Bq)	<input checked="" type="checkbox"/> Exempt (Bq/g)
		<input type="checkbox"/> $h_{0.07}$ (μ Sv/h/MBq) @ 10 cm	<input checked="" type="checkbox"/> A / A_2
		<input type="checkbox"/> h_{10} (μ Sv/h/MBq) @ 1 m	<input checked="" type="checkbox"/> $A /$ Excepted
		<input type="checkbox"/> H_{10} (μ Sv/h) @ 10 cm	<input checked="" type="checkbox"/> A (Bq) / Exempt (Bq)
		<input type="checkbox"/> CA (Bq/m ³)	<input checked="" type="checkbox"/> A (Bq/g) / Exempt (Bq/g)
		<input type="checkbox"/> CS (Bq/cm ²)	



e-Ship: radiological transport assistant

- 1. What is e-Ship?
- 2. Why e-Ship ?
Background information on nuclear transports
- 3. Dangerous Goods Regulations
- 4. e-Ship user interface:
My Packages
Edit, Report
Options
Import
Sample packages
- 5. My 1st packages !



e-Ship: nuclear material transport report

Transport report generated for source: Simple Package (Exempted) by magltest on Aug 30, 2012 14:02:31

Package name: Simple Package (Exempted)
Description: Containing the three nuclides: Co-57, Co-58, Fe-59
Source: Material, Other form, Solid
Host material mass: 1 g

Source characterisation

Nuclide	Half life	Mass (g)	Activity (Bq)	Heat (W)	Gamma dose rate H _{0.05} (Sv/h) at 10 cm
Co-57	271 d	3.84e-11	1.20e+4	2.76e-10	2.52e-2
Co-58	70.8 d	1.05e-11	1.24e+4	2.00e-9	1.82e-1
Fe-59	44.5 d	5.43e-11	1.00e+5	2.09e-8	1.75e+0
Total		1.03e-10	1.24e+5	2.32e-8	1.96e+0

Package characterisation

Nuclide	Activity (Bq)	Exempt (Bq)	Exempt (Bq)	Exempt (Bq)	A ₁ (Bq)	A ₂ (Bq)	A ₁ /A ₂	A ₁ /A ₂	A ₁ /A ₂
Co-57	1.20e+4	1.00e+6	1.00e+2	1.00e+1	1.00e+1	1.20e+2	1.20e+2	1.20e+2	1.20e+2
Co-58	1.24e+4	1.00e+6	1.00e+1	1.00e+0	1.00e+0	1.24e+2	1.24e+2	1.24e+2	1.24e+2
Fe-59	1.00e+5	1.00e+6	1.00e+1	1.00e-1	1.00e-1	1.00e+4	1.11e+4	1.11e+4	1.11e+4
Total	1.24e+5					1.24e+3	1.11e+4	1.25e+4	1.25e+4

Exempted Package

The total dose rate at surface should be < 5pSv/h; calculated γ dose rate at 10 cm = 1.96e+0 pSv/h. If the surface gamma dose rate is ≥ 5pSv/h you should use a Type A package.

Aug 30, 2012 14:02:31



1. What is e-Ship?

e-Ship (electronic Shipment) is a software program for calculating radiological characteristics of packages for the shipment of radioactive material in accordance with ADR/IATA/IAEA/CFR49 transport regulations. The program also allows the user to estimate the radiological impact of the shipment in the event of a release of the radioactivity into the environment. For this purpose data such as the inhalation dose, ingestion dose, external radiation dose (ambient dose equivalent rate, etc.) are given.

The program has been developed jointly by CERN and Nucleonica.



2. Why e-Ship ?

Background information on nuclear transports

- Each year about 10 million packages of radioactive materials are transported worldwide by land, sea and air.
- Radionuclides are used for a variety of purposes e.g. in nuclear medicine, materials testing, oil exploration etc.
- For these purposes radioactive materials must be packaged and transported to the location of interest. Before these materials can be shipped, care must be taken that the shipping regulations have been strictly followed.
- The purpose of these regulations is:
 - to ensure safety by containing the radioactivity to make sure that there is no negative effect on the environment
 - to control the radiation emitted from the package
 - make sure that nuclear fission criticality conditions cannot be met
 - and to dissipate any heat generated within the package.

- Full details are given in the Nucleonica Wiki page on e-Ship

The screenshot shows the Nucleonica Wiki page for 'Help:E-Ship'. The page has a navigation sidebar on the left with sections: navigation (Main Page, Help, Glossary, Element Information, ReadingRoom, Gallery of Nuclear Science, Weblinks, Karlsruhe Nuclide Chart, Premium Membership), support (Training Courses, Case Studies, Nucleonica Support), tools (Recent changes, Random page), search (a search box with 'Go' and 'Search' buttons), and toolbox (What links here, Related changes, Special pages, Printable version, Permanent link). The main content area is titled 'Help:E-Ship' and contains a 'Contents [hide]' section with a list of topics: 1 Introduction, 2 A₁ and A₂ Values (2.1 Example, 2.2 Transport Index), 3 Classification of Packages (3.1 Classification as an Excepted Package, 3.2 Classification as an Industrial Package, 3.3 Classification as a Type A package, 3.3.1 Activity Limits for Unknown Nuclides), 4 Radiation and Contamination Limits (4.1 Package Radiation Limits, 4.2 Package Contamination Limits, 4.3 Package Labels), 5 Getting Started, 6 e-Ship Web Application (6.1 What is e-Ship?, 6.2 e-Ship User Interface, 6.3 My Packages (6.3.1 Edit, 6.3.2 Report), 6.4 Options (6.4.1 General, 6.4.2 ICRP, 6.4.3 Swiss RPO, 6.4.4 IAEA Transport), 6.5 Import, 6.6 Activity limits, 6.7 Sample Packages, 6.8 My 1st Packages), 7 Data Validation (7.1 ADR 2013: verification and survey of activity limits (A₁, A₂,...), 7.2 Swiss Operational Radiation Protection (RPO) Data for 2013 in Nucleonica), and 8 References. Below the contents is the 'Introduction' section, which begins with the text: 'Each year about 10 million packages of radioactive materials are air. Radionuclides are used for a variety of purposes e.g. in nuclear exploration etc. For these purposes radioactive materials must be packaged and transported to the location of interest. Before these materials can be shipped, care must be taken that the shipping regulations have been strictly followed.'

3. Dangerous Goods Classification

• **Dangerous Goods Definition:** dangerous goods are substances or articles that pose a risk to people, property or the environment, due to their chemical or physical properties. These products are classified for transport. They are usually classified with reference to their immediate risk.

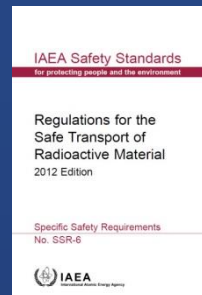


1. Explosive substances & Articles
2. Gases
3. Flammable Liquids
4. Other Flammable Substances
5. Oxidising Substances & Organic Peroxides
6. Toxic & Infectious Substances
- 7. Radioactive Materials**
8. Corrosive Substances
9. Miscellaneous Substances & Articles



Classification warnings diamond

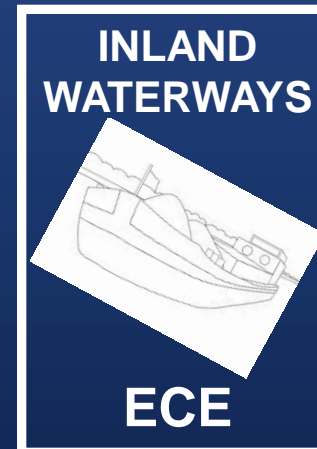
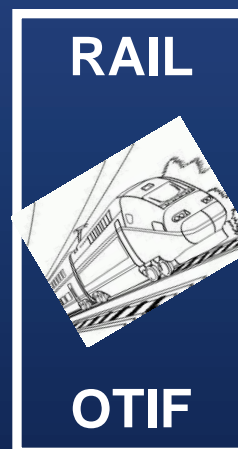
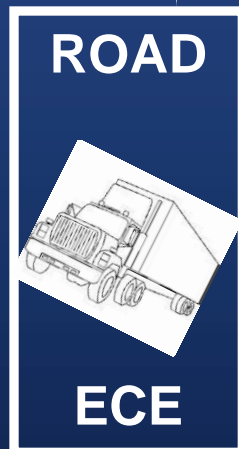
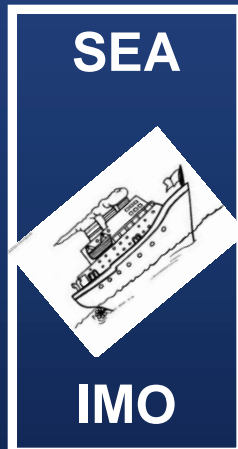




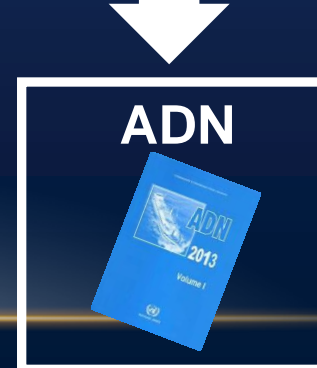
UN Recommendations & Model Regulations



Guidance

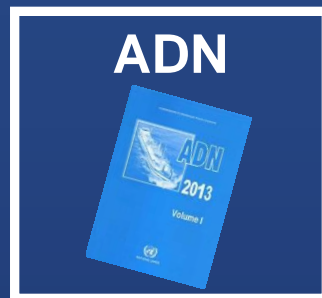
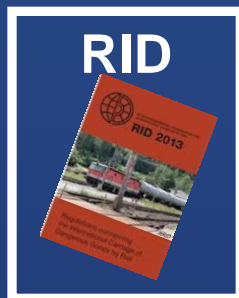
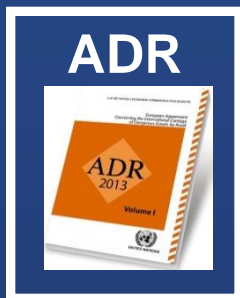


International
Regulatory Bodies



Global
Regulations

European
Regulations



Global
Regulations

European
Regulations



National Regulations

National
Regulations

Example in USA:

**Code of Federal Regulations #49
„Transportation“**



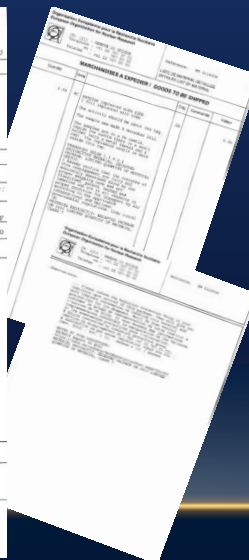
Dangerous Goods Regulations

No place for improvisation

- The IMDG Code (sea regulations) is more stringent than the ADR regulations (road). IATA (air) regulations are far more stringent.
- The IAEA regulations state that “persons engaged in the transport of radioactive material shall receive training in the contents of these regulations commensurate with their responsibilities” (concerns: design, manufacture, maintenance, classification, transport documents, carry or handle, mark, placard, load, unload, ...).

Organisation Européenne pour la Recherche Nucléaire European Organization for Nuclear Research		FACTURE PRO FORMA PRO FORMA INVOICE	
CH-1211 - GENEVE 23 SUISSE Téléphone : +41 22 767 80 00 Télécopie : +41 22 767 80 00 Télex : 220000		Numéro de commande : 123456789 (A reporter dans la réponse DDT - Please quote in your reply) Code bulgare : 000000	
Tech. contact : J. DONJOUX Tel: 76-72554 Transporteur / Carrier : FRANCOF S.A. 1211 GENEVE 15 AEROPORT SUISSE CDM : Expédié par / Sent by : AVIOM FIRST (GROUPE) LDV/Waybill		Destinataire / Consignee : Karlsruhe Institute of Technology Institute for Nuclear Physics (IHP) Hermann von Helmholtz Platz 1 D-76344 Eggenstein-Leopoldsdorf ALLEMAGNE Phone : +49 721 4700 4407	
Date de départ : 09/11/2012 Conditions de livraison / Delivery conditions : EXP Fraie à facturer au Client to be invoiced to : CHN		Date de départ : 09/11/2012 Conditions de livraison / Delivery conditions : EXP Fraie à facturer au Client to be invoiced to : CHN	
Marques et numéros : BN 1216906	Qté : 1 Colles / Packages : 1 Description : COULE 30x30x30 cm	Kg Brut : 5 Valeur totale DÉCLARÉ : CHF 5.00	Kg Net : 5 Valeur totale DÉCLARÉ : CHF 5.00
Quantité	Unité	Description	Orig. Commande
--- Voir liste détaillée annexée ---			
Pays de provenance / Country of origin : SUISSE Observations : --- Voir annexé ---		Pays de destination / Country of destination : ALLEMAGNE Observations : --- Voir annexé ---	
Nous soussignés, Organisation Européenne pour la Recherche Nucléaire, certifions que les marchandises susmentionnées sont expédiées en vertu de l'engagement, European Organization for Nuclear Research, hereby certify that the above mentioned goods are being sent		CERN Service Export 09/11/2012	

Organisation Européenne pour la Recherche Nucléaire European Organization for Nuclear Research		LISTE DE COUSAGE PACKING LIST	
CH-1211 - GENEVE 23 SUISSE Téléphone : +41 22 767 80 00 Télécopie : +41 22 767 80 00 Télex : 220000		Numéro de commande : 123456789 (A reporter dans la réponse DDT - Please quote in your reply) Code bulgare : 000000	
Tech. contact : J. DONJOUX Tel: 76-72554 Transporteur / Carrier : FRANCOF S.A. 1211 GENEVE 15 AEROPORT SUISSE CDM : Expédié par / Sent by : AVIOM FIRST (GROUPE) LDV/Waybill		Destinataire / Consignee : Karlsruhe Institute of Technology Institute for Nuclear Physics (IHP) Hermann von Helmholtz Platz 1 D-76344 Eggenstein-Leopoldsdorf ALLEMAGNE Phone : +49 721 4700 4407	
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--- Voir liste détaillée annexée ---			
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SHIPPER'S DECLARATION FOR DANGEROUS GOODS DECLARATION DE L'EXPÉDITEUR POUR MARCHANDISES DANGEREUSES			
Shipper / Expéditeur : CERN - YANN DONJOUX MailBox E08200 1211 GENEVA 23 SWITZERLAND Phone +41 76 487 0105		Air Waybill No. : N° de LTA Page 1 of 1 Pages Shipper's Reference Number : Références de l'expéditeur EDH 132456	
Consignee / Destinataire : NUCLEONICA - JOSEPH MAGILL c/o European Commission Hermann-von-Helmholtz-Platz 1 76344 Eggenstein-Leopoldshafen GERMANY Phone: +49 721 4700 4407		WARNING <i>Failure to comply in all respects with the applicable Dangerous Goods Regulations may be in breach of the applicable law, subject to legal penalties.</i> AVERTISSEMENT <i>Le non-respect sur quelque point que ce soit de la réglementation pour le transport des marchandises dangereuses peut constituer une infraction aux lois en vigueur, punissable par la loi.</i>	
Two completed and signed copies of this Declaration must be handed to the operator. Deux exemplaires remplis et signés doivent être remis à la compagnie.			
TRANSPORT DETAILS DETAILS DU TRANSPORT			
This shipment is within the limitations prescribed for: (delete non-applicable) Cette expédition est dans les limites autorisées sur: (rayer la mention inutile)		Airport of Departure : Aéroport de départ :	
PASSENGER AND CARGO AIRCRAFT AERONEFS PASSAGER ET CARGO		CARGO-AIRCRAFT-ONLY AERONEFS-CARGO SEULEMENT	
Airport of destination : Aéroport de destination :		Shipment type : (delete non-applicable) Type d'expédition : (rayer la mention inutile)	
<input type="checkbox"/> NON-RADIOACTIVE		<input type="checkbox"/> RADIOACTIVE	
NATURE AND QUANTITY OF DANGEROUS GOODS NATURE ET QUANTITE DE MARCHANDISES DANGEREUSES			
Dangerous Goods Identification Identification des marchandises dangereuses			
UN Group ID N°	Proper Shipping name Nom spécifique d'expédition	Class or Division (Subsidiary) Classe ou Division (Risques Subsidiaire)	Packing Group Groupe d'emballage
UN2915	RADIOACTIVE MATERIAL, TYPE A PACKAGE	7	I-125, SOLUTION LIQUID, 1 TYPE A PACKAGE x 11.1 GBq
Quantity and type of packing Quantité et type d'emballage		Packing Inst. Inst. d'emballage	Authorization Autorisations
II-YELLOW T1 0.2 DIM (L) 27.6x(W) 27.6x(H) 23.5 cm			
Additional Handling information : Informations complémentaires concernant la manutention : EMERGENCY CONTACT outside USA +41 22 767 3171 EMERGENCY CONTACT inside USA 011 41 22 767 3171 Name: DONJOUX Yann FOR RESEARCH PURPOSE ONLY			
Loading, stowage and carriage conform to ADR. No supplementary requirements necessary as per ADR 5.4.1.2.5.2a.			
I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labelled/placarded, and are in all respects in proper condition for transport according to applicable international and national government regulations. I declare that all of the applicable air transport requirements have been met.			
Je déclare que le contenu de ce chargement est décrit ci-dessus de façon complète et exacte par la désignation officielle de transport et qu'il est convenablement classé, emballé, marqué, étiqueté, placardé et à tous égards bien conditionné pour être transporté conformément aux réglementations internationales et nationales applicables. Je déclare que toutes les exigences du transport aérien qui lui sont applicables ont été remplies.		Name / Title of Signatory / Nom / Titre du signataire Stéphanie HARTMANN EXPORT OFFICER Place and Date / Lieu et date Geneva, 14 April 2013 Signature (see warning above) (voir avertissement ci-dessus)	



How are products classified ?

- For each classification of dangerous goods, there are different tests that are defined by the UN. These tests must be carried out to determine which classification the products fall under, and what packing group they should be assigned to.
- This allows the emergency services to determine what product is contained within a consignment. The consequences of ignoring dangerous goods can be catastrophic, resulting in massive damages to property, environment and people...
- Radioactive material shall be assigned to one of the UN numbers specified in regulations, depending on:
 - the activity level of the radionuclides contained in a package
 - the fissile or non-fissile properties of these radionuclides
 - the type of package to be presented for transport
 - the nature or form of the contents of the package or special arrangements



Hyundai Fortune – petroleum-based cleaning fluids placed near the engine room (failure to declare it)



EXEMPTIONS ?

- These regulations do not apply to:
 - Radioactive material that is an integral part of the means of transport;
 - Radioactive material moved within an establishment that is subject to appropriate safety regulations in force in the establishment and where the movement does not involve public roads or railways;
 - Radioactive material implanted or incorporated into a person or live animal for diagnosis or treatment;
 - Radioactive material in or on a person who is to be transported for medical treatment because the person has been subject to accidental or deliberate intake of radioactive material or to contamination;
 - Radioactive material in consumer products that have received regulatory approval, following their sale to the end user;
 - Natural material and ores containing naturally occurring radionuclides, which may have been processed, provided the activity concentration of the material does not exceed 10 times values specified in regulations {...}.
 - Non-radioactive solid objects with radioactive substances present on any surface in quantities not in excess of the levels defined in regulations.



THE PROCESS



CLASSIFY - IDENTIFY

Example: UN2916, RADIOACTIVE MATERIAL,
TYPE B(U) PACKAGE



PACKAGE (approved or ensuring compliance)



RADIATION, CONTAMINATION

**DOT USA/9283/B(U)-85
RADIOACTIVE MATERIAL
TYPE B(U) PACKAGE,
7, UN2916**

MARKING, LABELING and PLACARDING packages



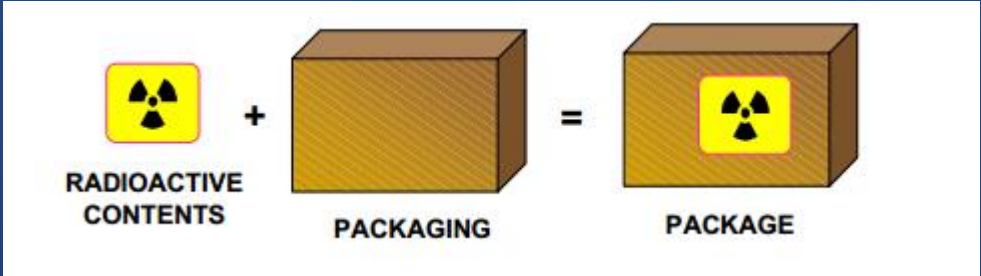
CLASSIFICATION OF MATERIAL

- Low specific activity (LSA) material: radioactive material which by its nature has a limited specific activity, or radioactive material for which limits of estimated average specific activity apply.
- Surface Contaminated Objects (SCO): a solid object which is not itself radioactive but which has radioactive material distributed on its surfaces.
- Special form radioactive material shall mean either an indispersible solid radioactive material or a sealed capsule containing radioactive material. Should resist to impact, percussion, bending, heat and water test.
- Low dispersible radioactive material: either a solid radioactive material or a solid radioactive material in a sealed capsule, that has limited dispersibility and is not in powder form.
- Fissile material: shall mean uranium-233, uranium-235, plutonium-239 and plutonium-241. Some exceptions exist
 - Uranium hexafluoride
 - Other form: everything which is not listed above...



Package: The packaging with its radioactive contents as presented for transport

Packaging: the assembly of components necessary to enclose the radioactive contents completely



A graded approach is applied in specifying the performance standards in these Regulations, which are characterized in terms of three general severity levels:

Routine conditions (incident free)	Normal conditions (minor mishaps)	Accident conditions of transport
Excepted Packages Industrial Packages IP-1	Industrial Packages IP-3 Type A Packages	Type B Packages Type C Packages (air)

(*) IP-2 packages are in-between Routine and Normal conditions (some tests satisfy the normal conditions but not all criteria are met).

EXCEPTED OR EXEMPTED ?

EXEMPTED: when the regulation does not apply
(for example: activity / contamination below a certain limit)

EXCEPTED: when part of the regulation applies (lighten)
(for example: empty package having contained radioactive material, low activity, ...)

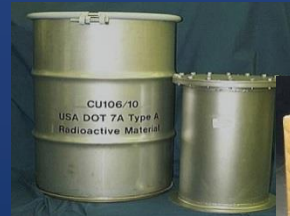


Packaging depends of

- the nature and activity of the material



Type C packages
(air)



Type B packages

Type A packages



Industrial packages
(for LSA / SCO)



Excepted packages



PACKAGE DETERMINATION

In summary, to classify a package, compare the activity of the content to the limit:

- A1 for special form content
- A2 for all other form
- Activity concentration for bulk material [Bq/g]
- Activity limit [Bq]

Activity < Activity concentration or < Activity Limit → EXEMPTED [Table 2]

Act. Conc./Limit < **Activity** < Table 4 → EXCEPTED

Table 4 < **Activity** < Table 2 (A1 or A2) → Type A

Table 2 < **Activity** → Type B or Type C
(activity within the limit of the certificate)

LSA / SCO → currently not supported by e-SHIP

Special values apply when A1/A2 are not defined

TABLE 2. BASIC RADIONUCLIDE VALUES

Radionuclide (atomic number)	A_1	A_2	Activity concentration limit for exempt material	Activity limit for an exempt consignment
	(TBq)	(TBq)	(Bq/g)	(Bq)
Actinium (89)				
Ac-225 (a)	8×10^{-1}	6×10^{-3}	1×10^1	1×10^4
Ac-227 (a)	9×10^{-1}	9×10^{-5}	1×10^{-1}	1×10^3
Ac-228	6×10^{-1}	5×10^{-1}	1×10^1	1×10^6

TABLE 4. ACTIVITY LIMITS FOR EXCEPTED PACKAGES

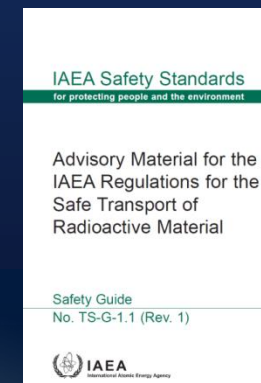
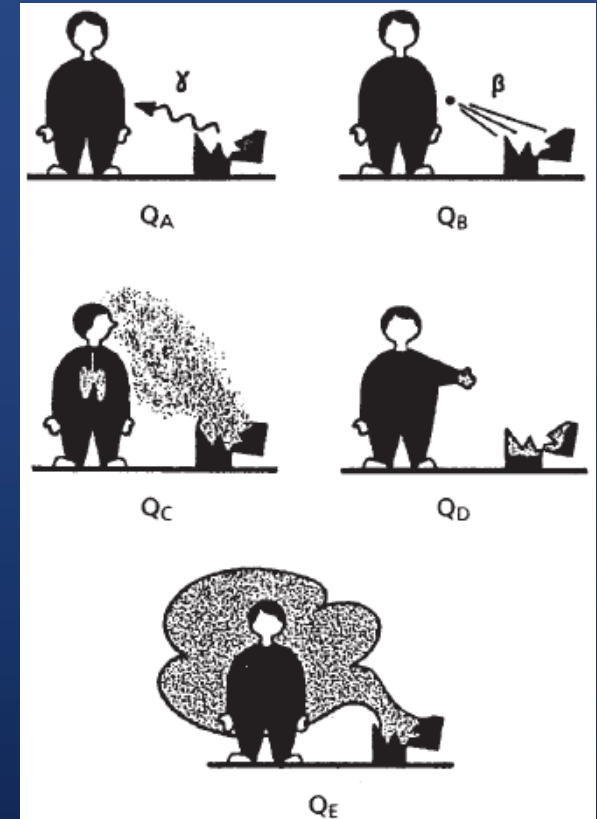
Physical state of contents	Instrument or article		Materials
	Item limits ^a	Package limits ^a	Package limits ^a
Solids:			
Special form	$10^{-3}A_1$	A_1	$10^{-3}A_1$
Other forms	$10^{-3}A_2$	A_2	$10^{-3}A_2$
Liquids	$10^{-3}A_2$	$10^{-1}A_2$	$10^{-4}A_2$
Gases:			
Tritium	$2 \times 10^{-2}A_2$	$2 \times 10^{-1}A_2$	$2 \times 10^{-2}A_2$
Special form	$10^{-3}A_1$	$10^{-2}A_1$	$10^{-3}A_1$
Other forms	$10^{-3}A_2$	$10^{-2}A_2$	$10^{-3}A_2$

^a For mixtures of radionuclides, see paras 405–407.

A1 / A2 – Why such values ? Where do they come from ?

Under the “Q system” a series of exposure routes is considered, each of which might lead to radiation exposure to persons in the vicinity of a Type A package involved in a severe transport accident :

- Qa external photon dose
- Qb external beta dose
- Qc inhalation dose
- Qd skin and ingestion dose
- Qe submersion dose
- Effective or committed dose to a person in the vicinity < 50 mSv
- < 0.5 Sv for individual organs or 0.15 Sv to the lens of the eye
- Assumed a person will remain at 1m from a damaged package for < 30 minutes



What is e-Ship? [bis repetita]....

e-Ship (electronic Shipment) is a software program for calculating radiological characteristics of packages and to help you choose the proper classification.

But remember that other characteristics might play a role. Dose rate in contact of the package is one example amongst others: the total dose rate at surface of an excepted package should be $< 5 \mu\text{Sv/h}$...



4. e-Ship user interface: My Packages

nucleonica ... web driven nuclear science

Applications Data Knowledge My Preferences Print Networking Nuclear Science Help New Browser

e-Ship
radiological transport assistant

Help → Getting started
Reference manual
Questions, remarks, suggestions can be posted in the **forum**

Main tabs → My Packages Edit Options Import Activity limits CERN file Sample packages About e-Ship

Package details →

My packages →

Package Name	Host mass (g)	Source	Form	State	Activity reported	last Modified	Download	Delete
(Create, import a new package)								
Simple Package	1	Material	Other	Solid	2012.08.21 10:19:05	2012.08.21 16:00:16		
My 1st Package (Type A)	50	Material	Other	Solid	2012.08.21 10:17:30	2012.08.21 16:00:02		
My 1st Package (exempted)	150	Material	Other	Solid	2012.08.21 10:16:21	2012.08.21 15:59:47		
My 1st Package (excepted)	50	Material	Other	Solid	2012.08.21 10:17:03	2012.08.21 15:59:36		
Manual	1	Material	Other	Solid	2012.08.15 11:09:27	2012.08.21 16:00:27		
Irradiated sample using 26 GeV protons	1	Material	Other	Solid	2012.05.24 08:00:00	2012.08.21 15:59:16		
Irradiated sample (iron)	1	Material	Other	Solid	2012.02.27 08:00:00	2012.08.21 15:59:02		
Total: 7								



4. e-Ship user interface:

Edit

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Questions, remarks, suggestions can be posted in the [forum](#)

Package description

My Packages Edit Options Import Activity limits CERN file Sample packages About e-Ship

Name (ID=109)
Simple Package (Excepted)

Description:
Containing the three nuclides: Co-57, Co-58, Fe-59.

Activity reported: 2012.08.10 08:00:00

Package characteristics

Source
☒ Material
☐ Instruments / Articles

Form
☒ Other
☐ Special

State
☒ Solid
☐ Liquid
☐ Gas

Host material: 1 g

Nuclide	Activity A (Bq)	A ₁ (TBq)	A ₂ (TBq)	Excepted (GBq)	Exempt (Bq)	Exempt (Bq/g)	A / A ₂	A / Excepted	A (Bq) / Exempt (Bq)	A (Bq/g) / Exempt (Bq/g)	Delete
Ni-57	1.20e+4	0.1	0.02	2.00e-2	10000	10	6.00e-7	6.00e-4	1.20	1.20e+3	
Co-58	1.24e+4	1	1	1.00	1.00E+06	10	1.24e-8	1.24e-5	1.24e-2	1.24e+3	
Fe-59	1.00e+5	0.9	0.9	0.900	1.00E+06	10	1.11e-7	1.11e-4	0.100	1.00e+4	
Total: 3	1.244e+5						7.23e-7	7.23e-4	1.31	1.24e+4	

Nuclide: Fe-59 Quantity: 1.00E+05 Unit: Becquerel Update

Save Package Reset Cancel Report

Package name

Package description

Activity reported

Nuclide activities

Activity limits
for transport

Transport report

4. e-Ship user interface: Report

e-Ship: nuclear material transport report



Transport report generated for source: Simple package (Excepted) by yd on Apr 16, 2013 19:13:33

Package name: Simple package (Excepted)

Description: Containing the three nuclides: Co-57, Co-58, Fe-59

Source: Material, Other form, Solid

Host material mass: 1 g

Activity reported: Jan 01, 2000 12:00:00

Source characterisation

Nuclide	Half-life	Mass (g)	Activity (Bq)	Heat (W)	Gamma dose rate H_{10} (μ Sv/h) at 10 cm	Radioactive contents	Notes
Co-57	271 d	3.84e-11	1.20e+4	2.76e-10	2.52e-2		
Co-58	70.8 d	1.02e-11	1.20e+4	1.94e-9	1.76e-1		
Fe-59	44.5 d	5.43e-10	1.00e+6	2.09e-7	1.75e+1		
Total:3		5.91e-10	1.02e+6	2.11e-7	1.77e+1		

Package characterisation

Nuclide	Activity (Bq)	Exempt (Bq)	Exempt (Bq/g)	Excepted (GBq)	A ₂ (TBq)	$\frac{A}{\text{Exempt}}$	$\frac{A(\text{Bq/g})}{\text{Exempt}(\text{Bq/g})}$	$\frac{A}{\text{Excepted}}$	$\frac{A}{A_2}$
Co-57	1.20e+4	1.00e+6	1.00e+2	1.00e+1	1.00e+1	1.20e-2	1.20e+2	1.20e-6	1.20e-9
Co-58	1.20e+4	1.00e+6	1.00e+1	1.00e+0	1.00e+0	1.20e-2	1.20e+3	1.20e-5	1.20e-8
Fe-59	1.00e+6	1.00e+6	1.00e+1	9.00e-1	9.00e-1	1.00e+0	1.00e+5	1.11e-3	1.11e-6
Total:3	1.02e+6					1.02e+0	1.01e+5	1.12e-3	1.12e-6

Excepted Package

The total dose rate at surface should be < 5 μ Sv/h; **WARNING:** calculated γ dose rate at 10 cm = 1.77e+1 μ Sv/h.
If the surface gamma dose rate is \geq 5 μ Sv/h you should use a Type A package.



4. e-Ship user interface: Options

Four main categories of Options:

- General (Half-lives, decay modes, etc.)
- ICRP (dose coefficients, etc.)
- Swiss RPO (h(0.07), h(10) etc.)
- IAEA Transport (A_1 , A_2 , etc.)

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radiological transport assistant

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Selected columns of the package grid

General	ICRP	Swiss RPO	IAEA Transport	Nucleonica
<input type="checkbox"/> MatIndex	<input type="checkbox"/> e_{ing} (Sv/Bq)	<input checked="" type="checkbox"/> LE (Bq)	<input checked="" type="checkbox"/> A_1	<input checked="" type="checkbox"/> γ dose rate
<input checked="" type="checkbox"/> Mass	<input type="checkbox"/> e_{inh} (Sv/Bq)	<input checked="" type="checkbox"/> LA (Bq)	<input checked="" type="checkbox"/> A_2	
<input checked="" type="checkbox"/> Half-life	<input type="checkbox"/> E_{ing} (mSv)	<input checked="" type="checkbox"/> A (Bq) / LE_{abs} (Bq)	<input checked="" type="checkbox"/> Excepted	
<input checked="" type="checkbox"/> Decay modes	<input type="checkbox"/> E_{inh} (mSv)	<input checked="" type="checkbox"/> A (Bq/kg) / LE (Bq/kg)	<input checked="" type="checkbox"/> Exempt (Bq)	
		<input checked="" type="checkbox"/> A (Bq) / LA (Bq)	<input checked="" type="checkbox"/> Exempt (Bq/g)	
		<input type="checkbox"/> $h_{0.07}$ (μ Sv/h/MBq) @ 10 cm	<input checked="" type="checkbox"/> A / A_2	
		<input type="checkbox"/> h_{10} (μ Sv/h/MBq) @ 1 m	<input checked="" type="checkbox"/> A / Excepted	
		<input type="checkbox"/> H_{10} (μ Sv/h) @ 10 cm	<input checked="" type="checkbox"/> A (Bq) / Exempt (Bq)	
		<input type="checkbox"/> CA (Bq/m ³)	<input checked="" type="checkbox"/> A (Bq/g) / Exempt (Bq/g)	
		<input type="checkbox"/> CS (Bq/cm ²)		


4. e-Ship user interface: Import

Before a user can upload his/her own nuclide datasets, some rules have to be observed for the data format in these files. The following delimiters are allowed: Comma , Semicolon ; Colon : Pipe | Octothorpe # TAB


The files can be created for example in a spreadsheet, but must be saved as csv files.

In the example shown, the nuclide name together with the nuclide activity is shown with a comma , as delimiter. Currently only the activity can be accepted as input.

CERN .txt files: It is also possible to upload dedicated format CERN gamma spectrum files

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radiological transport assistant

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Browse a file to be imported:

Import / Upload files:

- CSV: consisting of rows with at least (see example file below)
 - Nuclide name (e.g.: Co-60), Activity (in Bq)
- TXT: only for special CERN spectrum file format

Decimal separator

☒ Period1/2 = 0,5

☐ Comma1/2 = 0,5

File to be imported:

Nuclide,	Activity (Bq)
Co-60,	1.5e6
Cs-137,	1000
I-123,	20000
Tc-99m,	3.7e10


4. e-Ship user interface: Activity limits (IAEA)

The Activity limits tab contains the A1 and A2 values together with the activity concentration for exempt material (Bq/g) and the activity limit for an exempt consignment (Bq). In addition a brief description and notes are given.

Care must be exercised when using nuclides in packages which are not in the IAEA Activity limits table. When a nuclide has been added to the package, it should be checked in the Activity limit tab to see if there is an entry. If there is no entry, this means that it is an unknown nuclide. In this case, the user must look up the datasheets for the appropriate nuclear data .

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e-Ship

radiological transport assistant

This is a *beta* version of the new web application e-Ship. Please report errors to info@nucleonica.com.

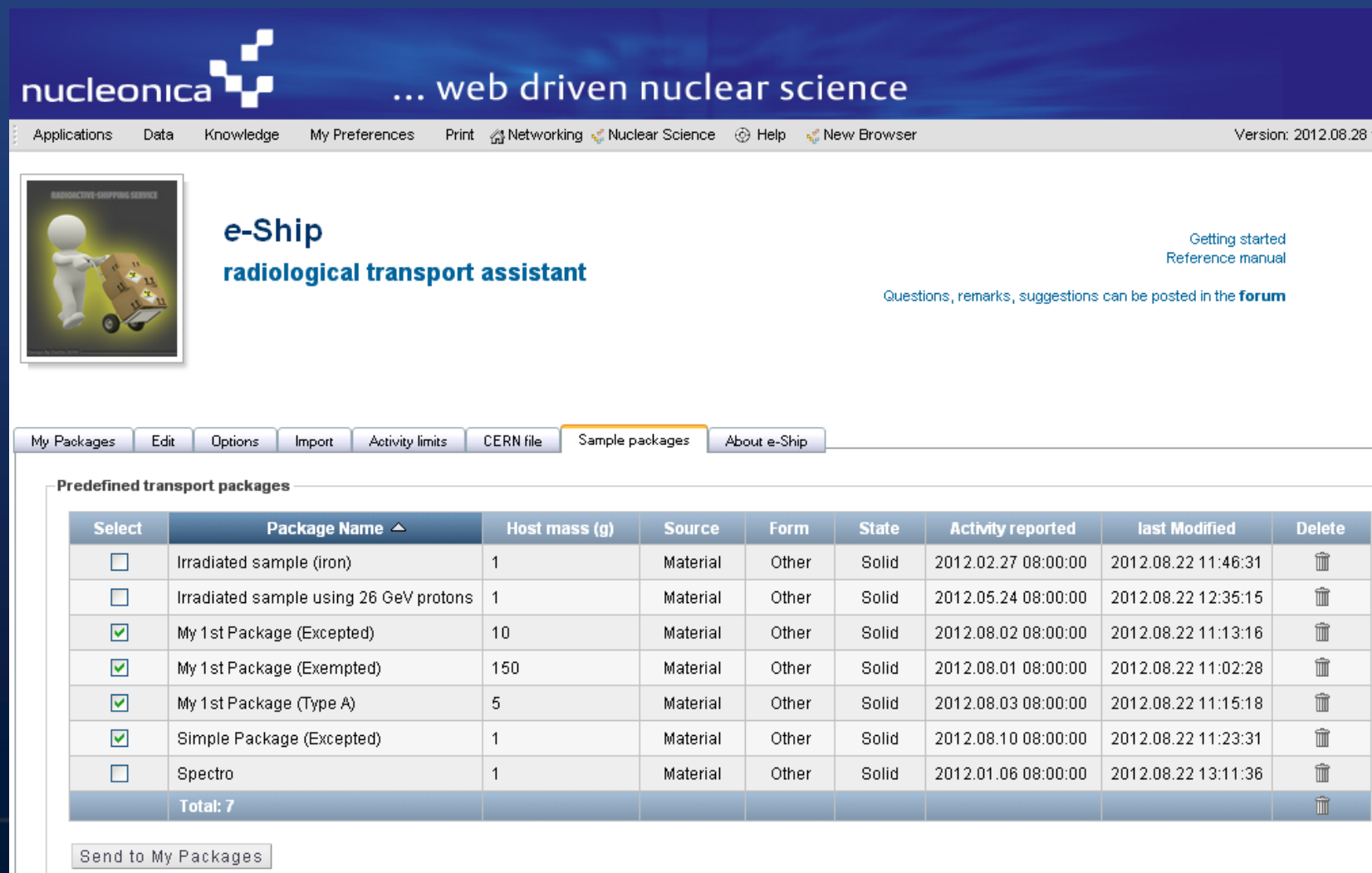
My PackagesEditOptionsImportActivity limitsCERN fileSample packagesAbout e-Ship

Nuclide	Half-life	A1 (TBq)	A2 (TBq)	Activity concentration for exempt material (Bq/g)	Activity Limit for an exempt consignment (Bq)
55 Cs131	9.69 d	30	30	1.00E+03	1.00E+06
55 Cs129	1.342 d	4	4	1.00E+02	1.00E+05
24 Cr51	27.703 d	30	30	1.00E+03	1.00E+07
27 Co60	5.271 y	0.4	0.4	1.00E+01	1.00E+05
27 Co58m	8.9 h	40	40	1.00E+04	1.00E+07
27 Co58	70.86 d	1	1	1.00E+01	1.00E+06
27 Co57	271.80 d	10	10	1.00E+02	1.00E+06
27 Co56	77.31 d	0.3	0.3	1.00E+01	1.00E+05
27 Co55	17.53 h	0.5	0.5	1.00E+01	1.00E+06
96 Cm248	340 ky	0.02	0.0003	1.00E+00	1.00E+03
96 Cm247	16.0 My	3	0.001	1.00E+00	1.00E+04
96 Cm246	4.73 ky	9	0.0009	1.00E+00	1.00E+03
96 Cm245	8.5 ky	9	0.0009	1.00E+00	1.00E+03
96 Cm244	18.0 y	20	0.002	1.00E+01	1.00E+04
96 Cm243	30 y	9	0.001	1.00E+00	1.00E+04
96 Cm242	162.93 d	40	0.01	1.00E+02	1.00E+05
96 Cm241	32.8 d	2	1	1.00E+02	1.00E+06
96 Cm240	27 d	40	0.02	1.00E+02	1.00E+05
17 Cl38	37.2 m	0.2	0.2	1.00E+01	1.00E+05
17 Cl36	301.0 ky	10	0.6	1.00E+04	1.00E+06

4. e-Ship user interface: Sample Packages

The Sample packages tab contains a list of pre-defined sample packages.

By transferring these packages to the user's own "My Packages", sample packages are immediately available for testing.



The screenshot displays the nucleonica web interface for the e-Ship radiological transport assistant. The header includes the nucleonica logo and the tagline "... web driven nuclear science". A navigation bar at the top contains links for Applications, Data, Knowledge, My Preferences, Print, Networking, Nuclear Science, Help, and New Browser. The version is noted as 2012.08.28.

The main content area features the e-Ship logo and a description: "e-Ship radiological transport assistant". Links for "Getting started" and "Reference manual" are provided, along with a note that questions can be posted in the forum.

A tabbed interface at the bottom shows several tabs: My Packages, Edit, Options, Import, Activity limits, CERN file, Sample packages (selected), and About e-Ship.

The "Sample packages" tab displays a table titled "Predefined transport packages". The table has columns for Select, Package Name, Host mass (g), Source, Form, State, Activity reported, last Modified, and Delete. The data rows are as follows:

Select	Package Name ^	Host mass (g)	Source	Form	State	Activity reported	last Modified	Delete
<input type="checkbox"/>	Irradiated sample (iron)	1	Material	Other	Solid	2012.02.27 08:00:00	2012.08.22 11:46:31	
<input type="checkbox"/>	Irradiated sample using 26 GeV protons	1	Material	Other	Solid	2012.05.24 08:00:00	2012.08.22 12:35:15	
<input checked="" type="checkbox"/>	My 1st Package (Excepted)	10	Material	Other	Solid	2012.08.02 08:00:00	2012.08.22 11:13:16	
<input checked="" type="checkbox"/>	My 1st Package (Exempted)	150	Material	Other	Solid	2012.08.01 08:00:00	2012.08.22 11:02:28	
<input checked="" type="checkbox"/>	My 1st Package (Type A)	5	Material	Other	Solid	2012.08.03 08:00:00	2012.08.22 11:15:18	
<input checked="" type="checkbox"/>	Simple Package (Excepted)	1	Material	Other	Solid	2012.08.10 08:00:00	2012.08.22 11:23:31	
<input type="checkbox"/>	Spectro	1	Material	Other	Solid	2012.01.06 08:00:00	2012.08.22 13:11:36	
Total: 7								

At the bottom of the table, there is a button labeled "Send to My Packages".

5. e-Ship user interface: My 1st packages !

In this first example, a package consisting 1 kBq of Cobalt-60 is created. The activity was reported on 1st Aug. 2012. Default package characteristics are assumed (material, solid, other form). In the nuclide table only the IAEA Transport values are shown for clarity. A host material mass of 150 g was set. The transport report can be generated by clicking on the Report button at the bottom of the page. The Report is shown in the following figure.



e-Ship radiological transport assistant

My Packages

Edit

Options

Import

Activity limits

CERN file

Sample packages

About e-Ship

Name (ID=86)

My 1st Package (Exempted)

Description:

Package contains the nuclide: Co-60 (1000 Bq);
This package was characterised on 1 August 2012 as Material, Other form and Solid.
Host mass is 150 g

Activity reported:2012.08.01 08:00:00

Nuclide	Activity A (Bq)	A ₁ (TBq)	A ₂ (TBq)	Excepted (GBq)	Exempt (Bq)	Exempt (Bq/g)	$\frac{A}{A_2}$	$\frac{A}{\text{Excepted}}$	$\frac{A \text{ (Bq)}}{\text{Exempt(Bq)}}$	$\frac{A \text{ (Bq/g)}}{\text{Exempt(Bq/g)}}$	Delete
Co-60	1.00e+3	0.4	0.4	0.400	1.00E+05	10	2.50e-9	2.50e-6	1.00e-2	0.667	

Package characteristics

Source

☒ Material

☐ Instruments / Articles

Form

☒ Other

☐ Special

State

☒ Solid

☐ Liquid

☐ Gas

Host material:150g



Thank You!

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